Mission to Investigate Ice Keel Scour Marks on Mars

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We propose a mission to Mars to investigate ice keel scour marks. Scour marks are proxy indicators of an ancient large, ice-covered body of water. By analogy with ice scour processes occurring on earth today, Martian ice scour marks are excellent candidate targets for finding possible evidence of former life.

There is controversy over whether an ocean, or oceans, once existed in the north polar basin of Mars. Using surface morphologic features imaged by the Viking orbiters a northern hemisphere ocean, centred around the north pole, was proposed by Parker *et al.* (1989; 1993), and reinforced by the work of Scott *et al.* (1992; 1995) who proposed a series of large polar seas. Parker *et al.* (1989) proposed and mapped two continuous possible ancient shorelines (Contact 1 and Contact 2) that encircle the polar basin. The morphologic interpretations of Contacts 1 and 2 were tested by Head *et al.* (1998; 1999) who used Mars Orbiter Laser Altimeter (MOLA) data to determine the likelihood that both Contacts were once equipotential lines, and therefore compatible with the existence of one or more flood level. Head *et al.* (1999) also used the MOLA data to create a digital elevation model of the polar basin and discovered the presence, in several regions below the altitude of Contact 2, a number of horizontal terraces possibly related to former stillstand positions of the purported ocean.

We present an evolving theory based on preliminary analyses of Mars Global Surveyor Mars Orbiter Camera images that ice keel scour marks, made by floating ice in an ancient north polar basin ocean, are present in parts of the basin. We base our interpretation on regional morphology of individual scour marks and on scour mark patterns.

The scientific approach to developing a mission to Mars has the following components:

- Development of diagnostic morphologic criteria to discriminate ice keel scour marks from other linear surface features on Mars through a detailed analysis of archived MOC images;
- Analogue studies of ice keel scour marks on King William Island;
- Development and integration by Guigné of a miniature drill bit ("Diamond Hammer Bit") with the Jet Propulsion Laboratory's existing and proven miniaturized USDC (UltraSonic Drill Corer);
- Development by Guigné and of a cone penetrometer/seismic receiver ("Acoustic Arrow"), for use in conjunction with the USDC as a seismic source; miniaturization in collaboration with the Jet Propulsion Laboratory;
- Selection of Mars landing sites for a smart lander/rover mission;
- Concept design review.

References

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